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DETERMINATION OF CLOUD LIQUID WATER DISTRIBUTION WITH 3D CLOUD TOMOGRAPHY

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ABSTRACT

There is an increasing need to determine the 3D distribution of the cloud liquid water content. ARM's potential move into scanning radar would be partly directed at this need. But there are also passive remote sensing options. One such option is microwave cloud tomography, originally presented by Warner et al. in 1980s. In this work, we revisit 3D cloud tomography as a potential routine means to measure cloud liquid water field at ARM sites. We find that the reconstruction of cloud liquid water field from microwave emission is highly ill-posed, and requires specific techniques to solve the ill-posed inverse problem. In this work, the method of truncated singular value decomposition is used to examine the ill-posedness of the problem, and obtain optimal solutions. Sensitivity studies show that the reconstruction quality is determined by number of radiometers, the total number of scanning angles, the noise level of the radiometers, and reconstruction resolution. With 4 microwave radiometers of typical noise level 0.3 K, the method is capable of retrieving the liquid water content to within 5% of the maximum water content in the simulated stratocumulus and broken cumulus clouds with a spatial resolution of a few hundred meters.